

WHAT IS CLAIMED IS:

1        1. A frame memory device which sequentially receives  
2        raster-scanned digital color image signals, and sequentially  
3        stores the image signals in a memory having a two-  
4        dimensional address structure, such that vertical addresses  
5        represent the order of entry of respective scan lines that  
6        constitute said image signals and horizontal addresses  
7        represent the order of entry of respective signals that  
8        belong to each of the scan lines, and which sequentially  
9        reads out the stored signals from said memory so as to  
10      output the signals again as raster-scanned signals, said  
11      frame memory device being characterized by comprising:  
12              signal rearranging means for rearranging the order of  
13        received signals to be stored in said memory; and  
14              subsampling and read-out means for reading out stored  
15        signals while skipping horizontal and vertical addresses of  
16        said memory at regular intervals, whereby the stored image  
17        signals that are subsampled are read out from said memory so  
18        as to output raster-scanned image signals at lower  
19        resolution than that of the received image signals.

1        2. A frame memory device according to Claim 1, wherein  
2        the received image signals comprise  $YC_B C_R$  color signals  
3        having a sampling ratio of 4:2:2, in which the number of  
4        horizontal pixels of  $C_B$  and  $C_R$  signals is equal to one half  
5        that of  $Y$  signals, and wherein the  $Y$  signals and the  $C_B$  and

6       $C_R$  signals are input and output in parallel with each other  
7      from a Y bus and a C bus, respectively, and the Y signals  
8      and  $C_B$  and  $C_R$  signals of a frame of said image signals are  
9      written into and read out from a Y memory and a C memory,  
10     respectively, constituting said memory, with the Y and C  
11     signals transmitted in parallel with each other, said  $C_B$  and  
12      $C_R$  signals being multiplexed at alternate pixels and input  
13     and output from the C bus in the order of  $C_B \rightarrow C_R$ , and being  
14     characterized in that:

15        said signal rearranging means rearranges the  $C_B$  and  $C_R$   
16        signals in the order of  $C_B \rightarrow C_B \rightarrow C_R \rightarrow C_R$  to alternate the  
17        signals at every other pixel, and the  $C_B$  and  $C_R$  signals  
18        rearranged by said means are synchronized with the Y signals  
19        so that the Y and C signals are respectively written into  
20        said Y memory and said C memory in parallel with each other,  
21        and in that said subsampling and read-out means accesses  
22        alternate ones of horizontal and vertical addresses of said  
23        Y memory and C memory to read out the Y and C signals in  
24        parallel with each other, thereby to output raster-scanned  
25         $YC_BC_R$  image signals that have been subsampled to one half in  
26        both horizontal and vertical directions by said subsampling  
27        and read-out means.

1            3. A frame memory device according to Claim 1, wherein  
2        the received image signals comprise  $YC_BC_R$  color signals  
3        having a sampling ratio of 4:2:2, in which the number of  
4        horizontal pixels of  $C_B$  and  $C_R$  signals is equal to one half

5 that of Y signals, and wherein the Y signals and the C<sub>B</sub> and  
6 C<sub>R</sub> signals are input and output in parallel with each other  
7 from a Y bus and a C bus, respectively, and the Y signals  
8 and C<sub>B</sub> and C<sub>R</sub> signals of a frame of said image signals are  
9 written into and read out from a Y memory and a C memory,  
10 respectively, constituting said memory, with the Y and C  
11 signals transmitted in parallel with each other, said C<sub>B</sub> and  
12 C<sub>R</sub> signals being multiplexed at alternate pixels and input  
13 and output from the C bus in the order of C<sub>R</sub> → C<sub>B</sub>, and being  
14 characterized in that:

15 said signal rearranging means rearranges the C<sub>B</sub> and C<sub>R</sub>  
16 signals in the order of C<sub>R</sub> → C<sub>R</sub> → C<sub>B</sub> → C<sub>B</sub> to alternate the  
17 signals at every other pixel, and the C<sub>B</sub> and C<sub>R</sub> signals  
18 rearranged by said means are synchronized with the Y signals  
19 so that the Y and C signals are respectively written into  
20 said Y memory and said C memory in parallel with each other,  
21 and in that said subsampling and read-out means accesses  
22 alternate ones of horizontal and vertical addresses of said  
23 Y memory and C memory to read out the Y and C signals in  
24 parallel with each other, thereby to output raster-scanned  
25 YC<sub>B</sub>C<sub>R</sub> image signals that have been subsampled to one half in  
26 both horizontal and vertical directions by said subsampling  
27 and read-out means.

1 4. A frame memory device according to Claim 2,  
2 characterized in that horizontal scan frequency and vertical  
3 scan frequency of the image signals generated in a raster

4 scanning scheme from the frame memory device are equal to  
5 those of NTSC or PAL television signals.

1 5. A frame memory device according to Claim 3,  
2 characterized in that horizontal scan frequency and vertical  
3 scan frequency of the image signals generated in a raster  
4 scanning scheme from the frame memory device are equal to  
5 those of NTSC or PAL television signals.

1 6. A method of outputting raster-scanned digital color  
2 image signals at lower resolution than that of sequentially  
3 received raster-scanned digital color image signals,  
4 comprising:

5 rearranging the order of received signals;  
6 sequentially storing the rearranged signals in a memory  
7 having a two-dimensional address structure, such that  
8 vertical addresses represent the order of entry of  
9 respective scan lines that constitute the received image  
10 signals and horizontal addresses represent the order of  
11 entry of respective signals that belong to each of the scan  
12 lines; and

13 subsampling and reading out stored signals while  
14 skipping horizontal and vertical addresses of said memory at  
15 regular intervals;

16 wherein the rearranging and subsampling are correlated  
17 so as to output raster-scanned image signals at lower  
18 resolution than that of the received image signals.

1           7. A method according to Claim 6, wherein the received  
2 image signals comprise  $YC_B C_R$  color signals having a sampling  
3 ratio of 4:2:2, in which the number of horizontal pixels of  
4  $C_B$  and  $C_R$  signals is equal to one half that of Y signals,  
5 and wherein the Y signals and the  $C_B$  and  $C_R$  signals are  
6 input and output in parallel with each other from a Y bus  
7 and a C bus, respectively, and the Y signals and  $C_B$  and  $C_R$   
8 signals of a frame of said image signals are written into  
9 and read out from a Y memory and a C memory, respectively,  
10 constituting said memory, with the Y and C signals  
11 transmitted in parallel with each other, and wherein the  $C_B$   
12 and  $C_R$  signals are multiplexed at alternate pixels and input  
13 and output from the C bus in the order of  $C_B \rightarrow C_R$  and the  
14 received  $C_B$  and  $C_R$  signals are rearranged in the order of  $C_B$   
15  $\rightarrow C_B \rightarrow C_R$  to alternate the signals at every other pixel,  
16 and the rearranged  $C_B \rightarrow C_R$  signals are synchronized with the  
17 Y signals so that the Y and C signals are respectively  
18 written into said Y memory and said C memory in parallel  
19 with each other, and wherein the subsampling and reading out  
20 accesses alternate ones of horizontal and vertical addresses  
21 of said Y memory and C memory to read out the Y and C  
22 signals in parallel with each other, thereby to output  
23 raster-scanned  $YC_B C_R$  image signals that have been subsampled  
24 to one half in both horizontal and vertical directions.

1        8. A method according to Claim 6, wherein the received  
2        image signals comprise  $YC_B C_R$  color signals having a sampling  
3        ratio of 4:2:2, in which the number of horizontal pixels of  
4         $C_B$  and  $C_R$  signals is equal to one half that of Y signals,  
5        and wherein the Y signals and the  $C_B$  and  $C_R$  signals are  
6        input and output in parallel with each other from a Y bus  
7        and a C bus, respectively, and the Y signals and  $C_B$  and  $C_R$   
8        signals of a frame of said image signals are written into  
9        and read out from a Y memory and a C memory, respectively,  
10      constituting said memory, with the Y and C signals  
11      transmitted in parallel with each other, and wherein the  $C_B$   
12      and  $C_R$  signals are multiplexed at alternate pixels and input  
13      and output from the C bus in the order of  $C_R \rightarrow C_B$  and the  
14      received  $C_B$  and  $C_R$  signals are rearranged in the order of  $C_R$   
15       $\rightarrow C_R \rightarrow C_B \rightarrow C_B$  to alternate the signals at every other pixel,  
16      and the rearranged  $C_R \rightarrow C_B$  signals are synchronized with the  
17      Y signals so that the Y and C signals are respectively  
18      written into said Y memory and said C memory in parallel  
19      with each other, and wherein the subsampling and reading out  
20      accesses alternate ones of horizontal and vertical addresses  
21      of said Y memory and C memory to read out the Y and C  
22      signals in parallel with each other, thereby to output  
23      raster-scanned  $YC_B C_R$  image signals that have been subsampled  
24      to one half in both horizontal and vertical directions.

1           9. A method according to Claim 7, wherein signals are  
2 read out from said memory in a raster-scanning scheme having  
3 horizontal and vertical scan frequencies equal to those of  
4 NTSC or PAL television signals.

1           10. A method according to Claim 8, wherein signals are  
2 read out from said memory in a raster-scanning scheme having  
3 horizontal and vertical scan frequencies equal to those of  
4 NTSC or PAL television signals.

1           11. A method of writing and reading image signals,  
2 comprising the steps of:

3           dividing horizontal and vertical addresses of an  
4 address region of a memory storing the image signals into a  
5 plurality of blocks each having a predetermined number of  
6 addresses as a unit;

7           reading the image signals from each of said plurality  
8 of blocks, while skipping read-out addresses at  
9 predetermined intervals and subsampling the image signals;  
10 and

11           when the image signals are written into the memory,  
12 rearranging the image signals in an order that is determined  
13 based on the predetermined intervals at which the read-out  
14 addresses are skipped.

1           12. A method of writing and reading image signals  
2 according to Claim 11, wherein said image signals comprise  
3 raster-scanned color image signals having  $YC_B C_R$  signal  
4 components at a ratio of 4:2:2, and wherein said memory  
5 comprises a Y memory area that stores Y signals, and a C  
6 memory area that stores  $C_B$  signals and  $C_R$  signals, said Y  
7 signals being stored in the Y memory area of the memory  
8 without being rearranged, said  $C_B$  signals and  $C_R$  signals  
9 being rearranged in an order that is determined based on  
10 the predetermined intervals at which the read-out addresses  
11 are skipped, and stored in the C memory area of the memory.

1           13. A method of writing and reading image signals,  
2 comprising the steps of:

3           dividing horizontal and vertical addresses of a memory  
4 that stores raster-scanned color image signals having  $YC_B C_R$   
5 signals at a ratio of 4:2:2, into a plurality of blocks each  
6 having  $2m$  successive addresses as a unit, where  $m$  is a first  
7 integer;

8           reading the color image signals stored at  $2n$  addresses  
9 from each of said plurality of blocks, while skipping the  
10 addresses at predetermined intervals,  $n$  being a second  
11 integer, said first integer and said second integer being  
12 prime to each other, said first integer being larger than  
13 said second integer; and

14           when the color image signals are stored in said memory,  
15 storing Y signals into the memory in an order of entry

16 without performing rearrangement, while rearranging  $C_B C_R$   
17 signals in an order which is different from an order of  
18 entry and is determined based on the predetermined intervals  
19 at which the addresses are skipped, and storing the  
20 rearranged  $C_B C_R$  signals into the memory.

1 14. A memory device comprising:  
2 a memory having a two-dimensional address structure;  
3 writing means for sequentially receiving raster-scanned  
4 color image signals, and writing the color image signals  
5 into said memory such that vertical addresses of the memory  
6 represent an order of entry of scan lines that constitute  
7 the color image signals, and horizontal addresses of the  
8 memory represent an order of entry of the color image  
9 signals that belongs to each of the scan lines;  
10 reading means for sequentially reading out the stored  
11 color image signals from said memory, to output the signals  
12 as said raster-scanned color image signals; and  
13 signal rearranging means connected to an input terminal  
14 of said writing means, for changing an order of the color  
15 image signals to be entered into the writing means;  
16 wherein said reading means reads out the color image  
17 signals stored in said memory while subsampling the signals  
18 by skipping the horizontal addresses and vertical addresses  
19 of the memory at predetermined intervals.

1        15. A memory device according to Claim 14, wherein  
2        said predetermined intervals are regular intervals.

1        16. A memory device according to Claim 14, wherein the  
2        color image signals comprise raster-scanned color image  
3        signals having  $YC_B C_R$  signal components at a ratio of 4:2:2,  
4        and wherein said signal rearranging means rearranges the  
5        color image signals in an order that is determined based on  
6        said predetermined intervals at which the addresses are  
7        skipped when the color image signals stored in the memory  
8        are subsampled and read out.

1        17. A memory device comprising:  
2            a memory that stores raster-scanned color image signals  
3            having  $YC_B C_R$  signal components at a ratio of 4:2:2, said  
4            memory comprising a Y memory that stores Y signals of the  
5            color image signals, and a C memory that stores  $C_B$  and  $C_R$   
6            signals of the color image signals;  
7            a C bus through which the  $C_B$  and  $C_R$  signals of the color  
8            image signals are transmitted while being alternately  
9            multiplexed;  
10           a Y bus through which the Y signals of the color image  
11           signals are transmitted in synchronization with  $C_B$  and  $C_R$   
12           signals transmitted through said C bus;  
13           signal rearranging means connected to said C bus, for  
14           rearranging the multiplexed  $C_B$  and  $C_R$  signals to alternate  
15           the signals at every other pixel;

16           writing means for writing the Y signals from said Y  
17    bus, and the C<sub>B</sub> and C<sub>R</sub> signals rearranged by said signal  
18    rearranging means, into said Y memory and said C memory,  
19    respectively, in an order of raster-scanning; and

20           reading means for reading out the Y signals and C<sub>B</sub> and  
21    C<sub>R</sub> signals respectively stored at every other pixel in the Y  
22    memory and the C memory in the order of raster-scanning.

1           18. A memory device according to Claim 17, wherein an  
2    order of input and output of the C<sub>B</sub> and C<sub>R</sub> signals on said C  
3    bus and an order of rearrangement of the C<sub>B</sub> and C<sub>R</sub> signals by  
4    said signal rearranging means are determined based on the C<sub>B</sub>  
5    signals.

1           19. A memory device according to Claim 17, wherein an  
2    order of input and output of the C<sub>B</sub> and C<sub>R</sub> signals on said C  
3    bus and an order of rearrangement of the C<sub>B</sub> and C<sub>R</sub> signals by  
4    said signal rearranging means are determined based on a  
5    selected one of the C<sub>B</sub> signals and the C<sub>R</sub> signals.

1           20. A memory device according to Claim 17, wherein  
2    horizontal scan frequency and vertical scan frequency of the  
3    image signals read out from said memory in a raster-scanning  
4    scheme by said reading means are respectively equal to  
5    horizontal scan frequency and vertical scan frequency of  
6    NTSC or PAL television signals.

1        21. A memory device according to Claim 18, wherein  
2        horizontal scan frequency and vertical scan frequency of the  
3        image signals read out from said memory in a raster-scanning  
4        scheme by said reading means are respectively equal to  
5        horizontal scan frequency and vertical scan frequency of  
6        NTSC or PAL television signals.

1        22. A memory device according to Claim 19, wherein  
2        horizontal scan frequency and vertical scan frequency of the  
3        image signals read out from said memory in a raster-scanning  
4        scheme by said reading means are respectively equal to  
5        horizontal scan frequency and vertical scan frequency of  
6        NTSC or PAL television signals.